

Chapter 11 Testing

FMS construction culminates with a series of tests that confirm the full functionality of each component, subsystem, and the overall FMS. The designer must understand the rationale for these tests, the actual test requirements and procedures, the required test equipment and how the tests are reported in a written document to the Inspector.

11.1 Original Testing Requirements

Originally there were six types of tests, including:

- Design Acceptance Test (DAT);
- Factory Demonstration Test (FDT);
- Factory Acceptance Test (FAT);
- Stand Alone Test;
- Subsystem Acceptance Test (SST); and
- System Acceptance Test (SAT).

These tests were consolidated into the Stored Specifications, specifically within Section 105.04 – Control of Work.

11.2 Discontinued Tests for Established Technology

Recently, several of these tests have been judged to be no longer required for established technology. Specifically, the DAT, FDT, and FAT are no longer required.

The DAT required the contractor to host the designer and ADOT teams at the manufacturer's facility to verify mock-up models of FMS devices prior to actual production. This test was initially required given that the original system was considered not proven, thus giving an opportunity to bench test the FMS.

The FDT and FAT are further demonstrations of the FMS individual components at the manufacturer's facility. Like the DAT, these tests have not been required in the last several years for established technologies. Freeway DMS, CCTV cameras, several software packages furnished by ADOT, and other contractor provided equipment (Type 341 and 343 cabinets, Type 179 and Type 2070 controllers, certain non-intrusive detection technology, and other communications equipment) are now considered mature technologies, negating the need for these tests. In instances where a new vendor of a proven technology is being used for the first time, contractors have been required to submit certificates of compliance addressing the equipment and manufacturer's compliance with specifications and compatibility with the ADOT FMS.

In cases where a new vendor or technology is being used for the first time, the need for specialized tests for the DAT, FDT, and FAT should be considered by the designer. It is possible that one or all of these tests may need to be conducted in cases of truly new technology, manufacturing technique, the

implementation of a vastly different communications infrastructure, or new system software deployment. The ADOT TTG PM will judge the need for the re-introduction of these tests.

11.3 Required FMS Testing in Current Practice

The other FMS tests (Stand Alone, SST, and SAT) are crucial to the successful completion of the FMS construction. ADOT has gained considerable experience with the testing and results of these key tests. The designer should consult with the ADOT TTG PM as to whether the Stored Specification for 105.04 is sufficient for the project. The designer shall request the required test procedures from the ADOT TTG PM at the Stage III (60%) design level and review and modify the test procedures on a project specific basis. If the requested test procedures are not available, the designer shall create the test procedure. The Stage IV (95%) project submittal must include all the test procedures required for the project. It will be the designer's responsibility to coordinate with the ADOT PM to obtain the test procedures.

11.3.1 Stand Alone Test

The Stand Alone Test is intended to verify that the functionality of each FMS device (one by one) is fully compliant with the FMS standards. This test is conducted in the field at each individual FMS device location. The device must be proven to operate per specification independent of interconnection to the FMS software through the communication network. This test does not usually involve TOC personnel.

After the Stand Alone test is completed on each individual DMS sign on the project, a temporary 36" x 36" static sign shall be mounted on each structure support pole with a steel strap or band. The temporary signs shall face traffic and state a "SIGN NOT ACTIVE" message to alert motorists that the sign is not currently posting real time messages. Drilling into the structure support pole is not an option for mounting the sign.

11.3.2 Subsystem Acceptance Test (SST)

The SST verifies the communications system and device firmware with the respective FMS equipment for each subsystem (CCTV cameras, Freeway DMS, ramp meters/detection stations, etc.). Databases for each device type are typically updated and communications circuits are integrated at the TOC by ADOT or a subconsultant to ADOT TOC. The contractor must notify the TOC three weeks prior to the start of this test to ensure that all communication software is updated for the project. Communications with each device in the network is then monitored from the TOC by ADOT for a set test period using test software developed by ADOT specifically for the ADOT FMS databases. The test either passes or fails based on the number of errors, typically both over the entire test duration, typically 72 hours, and for a maximum number of errors within smaller durations of time. ADOT will not administer the SST. It will be the contractor's responsibility to administer the SST. The contractor must coordinate with ADOT during the SST and ADOT may provide some assistance where necessary.

11.3.3 System Acceptance Test (SAT)

The final test is a 30-day full System Acceptance Test, comprising of the proper operation of the overall system. This test is typically conducted by the operators at the TOC using designer provided test procedures that verify the system operates as expected in day-to-day operations.

Minor Failures

Certain minor failures may lead to a stop of the test. The 30-day test shall be suspended for the entire system for the following minor failure conditions:

- Interference with project operations due to vandalism, traffic accident, power failure, or lightning for which lightning protection devices as specified are not sufficient protection;
- Failure to complete the objective of any test scenario due to lack of adequate documentation for equipment supplied by the contractor. Failed tests shall be retested with revised documentation; and
- Intermittent hardware, software, communication, or operation control malfunctions.

Resumption of the test for the remainder of the 30-day period shall occur after satisfactory remedial action. For each restart, the 30-day test shall be extended by one day after the remediation is complete.

Major Failures

Major failures, or repetitive minor failures, may lead to a restart of the test upon correction of the issues. A major system failure is defined as one or more of the following conditions:

- Failure of any hardware or performance item to meet the operational requirements of the Special Provisions for 72 or more consecutive hours;
- Failure of ten percent or more of the existing or new controllers within any 72-hour period;
- Failure of an individual unit of equipment three or more times within five days for different reasons;
- Failure of five percent or more of all detectors, detector cards, CCTV, communication equipment, or AC isolators within a 14-day period; and
- Failure to correct any problem, as determined by the engineer, that adversely impacts the safety of the traveling public within four hours of notification.

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